

CLAIM SET AS AMENDED

1. (Currently Amended) A solid-state imaging device equipped with plural unit pixels each of which includes a photo-diode and a photo-detector on a substrate, the photo-diode comprising a charge generating region to generate charges upon light irradiation, the photo-detector comprising a charge accumulation region to accumulate the charges transferred from the charge generating region and generating a signal potential that changes in accordance with the amount of the charges in the charge accumulation region, the solid-state imaging device comprising:

a charge transfer region provided between the charge generating region and the charge accumulation region of the pixel, the charge transfer region forming a first potential barrier to the charges in the charge generating region, the first potential barrier being removable according to an applied voltage to the photo-detector,

a first charge eliminating region formed between the substrate and the charge accumulation region, the first charge eliminating region forming a second potential barrier to the charges in the charge ~~generating~~accumulation region, the second potential barrier being removable according to an applied voltage to the first charge eliminating region, and

when the first and second potential barriers are removed, the charges which have been accumulated in the charge generating region are eliminated to the substrate through the charge accumulation region before starting accumulation of the charges in the charge generating region, and then upon formation of at least the second potential barrier, the

charges start to be generated by light irradiation to the charge generating region, to accumulate the charges in the charge accumulation region, and

wherein formation of the first potential barrier after a predetermined time of the light irradiation prevents the charges that are generated by the light irradiation to the charge generating region from being transferred to the charge accumulation region, and then causes a signal potential that changes in accordance with the amount of the charges in the charge accumulation region to be generated as an image signal,

a second charge eliminating region formed near the charge generating region,

wherein the second charge eliminating region is a p + type impurity region formed on an upper surface of an n + type impurity region in the photo diode.

2. (Cancelled)

3. (Currently Amended) The solid-state imaging device according to claim 1, further comprising:

~~a second charge eliminating region formed near the charge generating region; and~~

a region, provided between the charge generating region and ~~the second charge eliminating~~ an overflow drain region, that forms a third potential barrier to the charges in the charge ~~accumulation~~ generating region, the third potential barrier being lower than the first

potential barrier such that the charges that are overflowed from the charge generating region are eliminated via the second charge eliminating region.

4. (Cancelled)

5. (Previously Presented) The solid-state imaging device according to claim 1, wherein the charge generating region has one conductive type, same as the substrate, and the photo-diode comprises a first region with opposite conductive type that contacts the charge generating region, and

wherein the photo-detector is a field effect transistor and comprises:

a channel region formed on the surfaces of the charge accumulation region with one conductive type and the charge transfer region with opposite conductive type;

a gate electrode formed on a gate insulation layer that is formed on the channel region;

a source region having opposite conductive type, the source region near the charge accumulation region being connected to the channel region; and

a drain region with opposite conductive type that is apart from the source region by the channel region, the signal potential being generated in the source region.

6. (Original) The solid-state imaging device according to claim 5, wherein the plural pixels are arranged in first and second directions to form a matrix, the source regions of the pixels along the first direction being connected to one another, the gate electrodes of the pixel along the second direction being connected to one another, and the drain regions of all pixels being common.

7. (Currently Amended) The solid-state imaging device according to claim 6, further comprising:

a switch circuit capable of electrically connecting and disconnecting the source region and the drain region of the pixel; and

~~a first~~ the first charge eliminating region formed between the substrate and the charge accumulation region, the charges in the charge accumulation region being eliminated to the substrate via the first charge eliminating region when the potentials of the charge accumulation region and the charge transfer region are increased by boosting up a voltage to the gate electrode,

wherein the voltage to the gate electrode is boosted by applying a voltage to the source and drain regions simultaneously while keeping the gate electrode at a high impedance state.

8. (Currently Amended) The solid-state imaging device according to claim 6, further comprising:

a second charge eliminating region with one conductive type formed near the charge generating region;

a second region with opposite conductive type, provided between the charge generating region and the second charge eliminating region, the second region forming a third potential barrier to the charges in the charge accumulation region, the third potential barrier being lower than the first potential barrier, such that the ~~charges,~~ charges that are overflowed from the charge generating region are eliminated via the second charge eliminating region.

9. (Cancelled)

10. (Withdrawn) A method of driving the solid-state imaging device according to claim 1, comprising the steps of:

(a) removing the first potential barrier in the charge transfer region to transfer the charged from the charge generating region to the charge accumulation region;

(b) eliminating the charges in the charge accumulation region to the substrate through the first charge eliminating region;

(c) storing the photo-generated charges in the charge generating region for a predetermined period;

(d) removing the first potential barrier to transfer the charges from the charge generating region to the charge accumulation region;

(e) detecting the signal potential of the photo-detector as the first signal potential;

(f) eliminating the charges in the charge accumulation region to the substrate through the first charge eliminating region;

(g) detecting the signal potential of the photo-detector as the second signal potential;

and

(h) subtracting the second signal potential from the first signal potential to output an image signal.

11. (Withdrawn) The method according to claim 10, wherein the steps (a) to (d) are carried out for all pixels at the same time, and the steps (e) to (h) are carried out for the pixels on a selected line.

12. (Withdrawn) The method according to claim 10, wherein the steps (c) and (d) are repeated in this order.

13. (Cancelled)

14 - 15. (Cancelled)

16. (Previously Presented) The solid-state imaging device according to claim 1, wherein the first potential barrier is formed while at least the second potential barrier is formed and charges start to be generated by light irradiation to the charge generating region, and the first potential barrier is removed while the charges are accumulated in the charge accumulation region.

17. (Previously Presented) The solid-state imaging device according to claim 3, wherein the first potential barrier is formed while at least the second potential barrier is formed and charges start to be generated by light irradiation to the charge generating region, and the first potential barrier is removed while the charges are accumulated in the charge accumulation region.

18. (Previously Presented) The solid-state imaging device according to claim 1, wherein the first potential barrier is removed and formed plural times while at least the second potential barrier is formed and the charges start to be generated by the light irradiation to the charge generating region, to accumulate the charges in the charge accumulation region.

19. (Previously Presented) The solid-state imaging device according to claim 3, wherein the first potential barrier is removed and formed plural times while at least the second potential barrier is formed and the charges start to be generated by the light irradiation to the charge generating region, to accumulate the charges in the charge accumulation region.

20. (New) A solid-state imaging device equipped with plural unit pixels each of which includes a photo-diode and a photo-detector on a substrate, the photo-diode comprising a charge generating region to generate charges upon light irradiation, the photo-detector comprising a charge accumulation region to accumulate the charges transferred from the charge generating region and generating a signal potential that changes in accordance with the amount of the charges in the charge accumulation region, the solid-state imaging device comprising:

a charge transfer region provided between the charge generating region and the charge accumulation region of the pixel, the charge transfer region forming a first potential barrier to the charges in the charge generating region, the first potential barrier being removable according to an applied voltage to the photo-detector,

a first charge eliminating region formed between the substrate and the charge accumulation region, the first charge eliminating region forming a second potential barrier to

the charges in the charge accumulation region, the second potential barrier being removable according to an applied voltage to the first charge eliminating region, and

when the first and second potential barriers are removed, the charges which have been accumulated in the charge generating region are eliminated to the substrate through the charge accumulation region before starting accumulation of the charges in the charge generating region, and then upon formation of at least the second potential barrier, the charges start to be generated by light irradiation to the charge generating region, to accumulate the charges in the charge accumulation region, and

wherein formation of the first potential barrier after a predetermined time of the light irradiation prevents the charges that are generated by the light irradiation to the charge generating region from being transferred to the charge accumulation region, and then causes a signal potential that changes in accordance with the amount of the charges in the charge accumulation region to be generated as an image signal, and

further comprising:

a second charge eliminating region formed near the charge generating region,

a region, provided between the charge generating region and an overflow drain region, that forms a third potential barrier to the charges in the charge generating region, the third potential barrier being lower than the first potential barrier such that the charges that are overflowed from the charge generating region are eliminated via the second charge eliminating region.